ANNELID JAWS FROM THE UPPER DEVONIAN OF NEW YORK.

By E. R. Eller.

INTRODUCTION.

The fossil annelid jaws described in this manuscript were collected at Alfred Station and at a gorge two miles to the south, near Tiptop, Allegany County, New York, and are from the Chemung or Canadaway formation of the Upper Devonian. They were found in fine-grained micaceous sandstone and shale. Flat black tubes of substance similar to that of the chitinous-like jaws are also plentiful. These serpulite tubes are about 50 mm. in length and 5 mm. in width. Foerste (1888) suggested that they may represent the chitinous skin of the annelids, the jaws of which are found nearby. This does not seem to be the case in the material under consideration because the jaw apparatus is too large for the size of the tubes. Among the chitinous-like fragments, which are so abundant on the surface of the rock, are plates which are tentatively referred to as elytra or horny scales of the somites. It is hoped that further search may bring to light many more of these interesting fossils.

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DISCUSSION

The literature concerning paleozoic annelid jaws is not very copious. The first known paper described and figured two broken jaws from the Cincinnati group and was published by Grinnell (1877). However, the true nature of these remains had been recognized by paleontologists prior to that date. Hinde (1882), in his paper on the *Annelids of Gotland*, records an interesting conversation and communication which he held with Professor Lindstrom in regard to the latter's predecessor, Professor Angelin, who had collected and recognized the true character of these fossils many years ago. Professor Lindstrom

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communicated to Hinde some remarks from a letter which he had received from Professor Angelin, dated June 19, 1864, Wisby, which are as follows: "The small hooked fragments from the waterfall near Wisby, of which you furnished me with great numbers, and which, moreover, are met with throughout Gotland, are the remains of Annelids—the jaws and cutaneous coverings." Professor Angelin had figured some examples of these jaws, together with some other fossils, but the plates were never published. According to Hinde the fact is clearly established, that to Professor Angelin "is due the credit of being the first to recognize the true characters of these small fossil jaws, and it gave me great pleasure to be able to bring forward this fresh proof of the knowledge and discernment of this able paleontologist."

The chief work on annelid jaws was carried out by Hinde who published four important papers on the subject. The first, in which he described annelid jaws from the Ordovician, Silurian, and Devonian formations in Canada, and from the Lower Carboniferous in Scotland, appeared in 1879. He discussed in this paper Dr. Heinrick Pander's monograph on fossil fish from the Lower Silurian (Ordovician) in Russia. Hinde believed that the annelid jaws he described under the genus *Eunicites* were very similar to the jaws figured as conodonts by Pander (1856) under the name *Aulocodus obliquus*. The following year, 1880, the annelid jaws from the Silurian of England were described by Hinde and two years later those from the Isle of Gotland. In 1896 he described and figured the articulated jaw, maxilla I, and some related jaws of the genus *Eunicites*.

James (1884) gave descriptions and figures for two new species of *Arabellites* from the Hudson River Group. Clarke (1887) published a plate illustrating a few annelid jaws, together with some conodonts, from the Hamilton group near Canandaigua, New York. One of the specimens figured by Clarke of the genus *Arabellites* is articulated, but is in a somewhat fragmentary condition. Foerste (1888) collected annelid jaws in the Brassfield at Todd's Fork, Ohio, and described and figured six new species. R. Etheridge, Jr. (1890, 1917) described three new species from the Upper Silurian in New South Wales. Some years later he added another species (doubtful) to the Australian list from the Upper Silurian of Bowning, New South Wales. Cleland (1911) figured a single species from the Devonian in Wisconsin. Parks and Fritz (1922) reproduced Hinde's figures and descriptions. Searight (1923) discussed fossil annelid jaws from a

Devonian limestone near Iowa City, Iowa. He did not attempt identification but compared the Paleozoic jaws with those of recent genera. Matern (1933) described a new species of *Nereidavus* from Germany.

The zoological position of fossil annelid jaws was discussed by Ulrich (1879). He compared some jaws from the vicinity of Cincinnati with some modern species and was of the opinion that they were true annelid remains. Ulrich did not figure any jaws in his paper, but it is probable that the material which he had in hand was that of annelids.

Hinde (1879) gave careful descriptions of both conodonts and annelid jaws and gave attention to the differences between these forms. Hinde (1882) submitted some of his Gotland specimens to Professor Ehlers, an authority on both living forms and fossil Solenhofen annelids, and it was his opinion that they were closely related to the families present in existing seas.

Rohon and Zittel (1886) concluded, after a thorough comparative study, that all such structures including the "conodonts" should be referred to as annelids. Miller (1889, 1892, 1897) was convinced that conodonts (including annelid species) were not the teeth of annelids, but belonged to the masticating apparatus of crustaceans. Harley (1861) was also of this opinion. Grabau and Shimer (1910), and Searight (1923) discussed the systematics of annelid jaws.

The classification of paleozoic annelid jaws has always been very difficult. This is due to the mode of preservation, the great variation within a genus and species, and to the asymmetrical variation of the jaws within an individual.

The fossil remains of paleozoic annelid jaws are composed of a substance which is not easily decomposed. They are usually found scattered in a haphazard manner over the surface of rocks and in some of the material under consideration there are approximately two hundred jaws to the square foot. Many jaws are found only in a fragmentary condition because of their brittleness and fineness of structure. With the exception of the articulated specimen figured in this paper, and in two other instances, Clarke (1887) and Hinde (1896), all jaw apparatus is found as isolated jaws. This makes the task of identifying them exceedingly difficult, and Hinde (1879) wrote ". . . . I have been obliged to describe the fossil jaws separately but without assuming that each isolated piece belongs to a different species, or even, in some cases, to a different individual, though it may fairly be

supposed, from the very numerous specimens, and their wide distribution in time and space, that there were many species of them." Hinde (1880) restated that in the classification of the jaws he was ". . . . thoroughly conscious of its tentative character, as serving for paleontological reference rather than as presenting exact zoological arrangement." Clarke (1887) considered specific identification impracticable, or at best inadvisable. Searight (1924) felt that "until more material has been obtained it does not seem profitable to attempt generic and specific descriptions."

Both fossil and modern annelid jaw apparatus is subject to individual variation and the different paired jaws of the maxilla are often asymmetrical. In the first maxilla the left or right jaw may be heavier than the opposite one, while the jaws of other maxilla may vary in

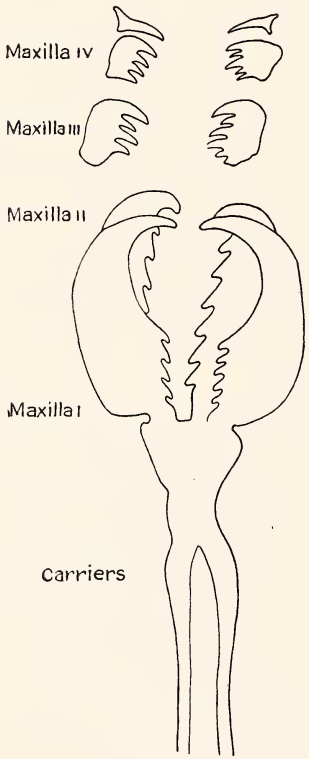

FIG. 1.
Arabella setosa Treadwell.

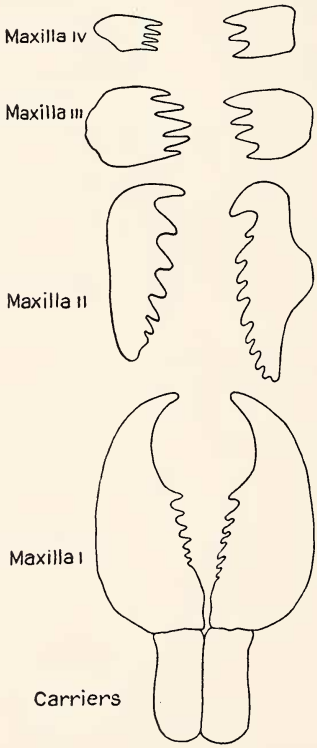

FIG. 2.
Arabellites sp. Schematic representation.

size and the denticles may differ in number. In view of the fact that the jaw apparatus is variable within the genus and species, an exact identification is not considered possible, and until a more satisfactory method is found, the classification will follow that of other authors.

The jaw apparatus of *Arabella setosa* Treadwell, figure 1, is reproduced to show the general arrangement of the jaws of the maxilla. Figure 2 is a schematic reconstruction of *Arabellites* sp.

An isolated plate carrying a series of denticles on the inner free margin is a "jaw." In the jaw apparatus, jaws are found in pairs which are called maxilla I, II, III, IV, etc., the latter term being used in the literature in the singular and sometimes in the plural "maxillæ." The jaws of maxilla I usually end in a prominent curved tooth called a "hook." An extended portion of the anterior margin of a jaw is called a "shank." The two plates at the base of maxilla I are called "carriers."

DESCRIPTION OF SPECIES

Genus EUNICITES, Ehlers, 1868

The annelid jaw apparatus described under the genus *Eunicites* are from maxilla II, III, and IV. No jaws that could be associated with maxilla I were found. Jaws referred to maxilla II are comparatively elongate, rudely triangular with a shank extended from the anterior margin and the free edge furnished with blunt denticles. Jaws of maxilla III and IV are smaller, crudely square or oblong, with a series of blunt or pointed denticles.

Eunicites anchoralis sp. n.

MAXILLA II (Plate XXII, figs. 1-5)

Jaw narrowly lanceolate or triangular; anterior margin wide, slightly rounded, and extended to a pointed shank; outer margin curved anteriorly and then straight to the posterior extremity; free inner margin carries from 7 to 11 large, blunt, triangular denticles. The second denticle is often minute.

This form is similar to *Eunicites cristatus*, Hinde and *Eunicites hebes*, Hinde. Many recent genera besides *Leodice* Savigny (formerly *Eunice* Cuvier) have the jaws of maxilla II of this form and may be compared favorably with them.

Eunicites caulis sp. n.

MAXILLA II (Plate XXII, figs. 26-28)

Jaw long and crudely triangular; anterior end greatly rounded and extended to a short pointed shank; outer lateral margin a straight edge, terminating in a blunt posterior extremity; inner lateral margin carries an irregular series of flat, blunt denticles which are often lacking anteriorly.

These jaws are not altogether characteristic of the genus *Eunicites* Ehlers, nor do they resemble very closely the jaws of maxilla II of recent forms. If this form is compared with the foregoing species one may observe that *Eunicites caulis* m. is longer in length, the shank smaller, and the denticles more irregular.

Eunicites mutabilis sp. n.

MAXILLA III and IV. (Plate XXII, figs. 6-14)

Jaw irregularly oblong or square; outer margin with aperture for insertion of muscle; inner free margin carries from 3 to 6 denticles which are round and blunt in the larger jaws and acute and conical in the smaller ones.

In general, however, the jaws resemble those of maxilla III and IV of the existing genera *Leodice* Savigny, (*Eunice* Cuvier), and *Arabella* Grube. Hinde considered jaws of this type more closely related to *Leodice*, (*Eunice*). Figs. 10 to 13 are comparable to the jaws of maxilla III and IV, plate XXIII, figs. 2 and 1 of *Arabellites alfredensis* m.

Genus OENONITES, Hinde, 1879

"Jaws with a more or less curved anterior hook, followed by a series of smaller teeth, similar in character to those of the existing genus Oenone." Hinde.

Oenonites grandidentatus sp. n.

MAXILLA II (Plate XXII, figs. 15-25)

Jaw oblong, tapering posteriorly; denticles very large, flat, blunt, and triangular, the most anterior denticle usually curved and not always the largest. The muscular attachment is under and along the outer margin.

This type of jaw is placed under the genus *Oenonites* by Hinde. They resemble, however, the jaws of maxilla II of *Arabellites alfredensis* m., plate XXIII, fig. 3, quite closely. The resemblance is also close between these fossil jaws and the jaws of maxilla II of the recent genus *Arabella* Grube.

Genus ARABELLITES, Hinde, 1879

"I propose to include in this genus jaws of widely different form, which have a general resemblance to those of the existing genus *Arabella*, Grube.

"1. Jaws with an extremely prominent anterior hook, and a row of smaller teeth on a wide base;

"2. Sickle-shaped jaws and allied forms;

"3. Jaws subquadrate in form, with a straight upper edge of small teeth. Those of the first division appear to correspond with the first pair, the second resemble the second pair, as figured in Cuvier's "*Regne Animal*," of *Arabella* (*Oenone*) *maculata*, Edwards; whilst the square-shaped jaws I regard as belonging to the lower jaw of Annelids of this genus. Examples of these different forms are very abundant, not only in the Cambro-Silurian, but in all the other formations where the Annelid remains appear." Hinde.

Arabellites alfredensis sp. n.

MAXILLA I, II, III and IV (Plate XXIII, figs. 1-4)

The articulated jaws of maxilla I, fig. 4, and the three isolated jaws of maxilla II, III and IV, figs. 3, 2 and 1, figured under this species were collected at Alfred Station, New York. A jaw of maxilla II, fig. 3, was found to the right of the jaws of maxilla I, fig. 4, and partly underneath the right one. Less than one inch away the jaws of maxilla III and IV, figs. 2 and 1, were discovered. No other annelid jaws have been found at this locality in four years of intensive collecting. As to size, the jaws are in good proportion to each other and compare favorably to ratios in recent annelid jaw apparatus. For these reasons, and since they were found so close together, it seems more than probable that the jaws are all from the same individual. Thus, they are figured as the same species.

MAXILLA I, fig. 4

Carriers oblong, united along the middle line; posterior margin rounded, with a slight incision; anterior margin truncate with an acute incision; lateral margins irregularly curved but parallel to the middle line; surface sculpture irregular with a protuberance at the anterior margin. The carriers unite with the jaws forming a well defined groove.

Jaw heavy, broad, and asymmetrical, with 6 to 10 curved, conical denticles; lateral margin angularly rounded to the obliquely truncated

posterior margin; 2 to 3 knob-like elevations along the posterior margin; surface irregularly sculptured with gently rounded ridges and furrows parallel to the lateral margins; jaws terminate with stoutly curved hooks which are nearly at right angles to the lateral margins. This form resembles *Arabellites hamatus* Hinde but differs somewhat in size, outline, and surface sculpture.

The wide incision at the distal end of the carriers, the sculpture at the lower part of the inner margin of the jaws, and the presence of the knob-like protuberances suggest that the right jaw slightly overlapped the left one when in operation.

A characteristic of the modern genus *Arabella* Grube, which Hinde used as a comparison for his fossil genus *Arabellites*, possesses very long slender processes or stalks as carriers. The fossil specimen under consideration does not show morphologically any evidence of having had basal stalks or any processes attached to the carriers. The carriers compare more favorably with the modern genus *Lumbrienereis*, de Blainville.

MAXILLA II, fig. 3

Jaw lanceolate; anterior margin rounded and terminating with a robust curved hook; outer lateral margin straight with a large inflation midway; inner lateral margin nearly straight and with 8 heavy, flat, triangular denticles. There are probably two more denticles on the jaw, but they are hidden under the right jaw of maxilla I.

MAXILLA III, fig. 2

Jaw triangular; anterior margin slightly rounded, outer margin irregular and possibly broken; inner margin straight with 5 conical denticles.

MAXILLA IV, fig. 1

Jaw nearly rhomboidal, wider than long; with 5 conical denticles, the first larger than the remaining four.

Hinde (1882) figures under the genus *Arabellites* several secondary jaws, figs. 50-63. None of these, however, compare particularly well with the jaws or maxilla II, III, and IV, figs. 3, 2, and 1, under consideration in this paper. Possibly better comparisons may be made with figs. 11, 16, 17-20, and 25-33 of Hinde's work, described under the genera *Eunicites* Ehlers and *Oenonites* Hinde.

Arabellites spatiosioris sp. n.

MAXILLA I (Plate XXIII, figs. 6, 7)

These jaws resemble *Arabellites alfredensis* m., plate XXIII, fig. 4 in size and general outline, but the surface sculpture is much smoother. They lack also the longitudinal ridges, the furrows, and the knob-like elevations at the proximal margin. The denticles may be considered similar to the foregoing species.

Arabellites latus sp. n.

MAXILLA I (Plate XXIII, fig. 5)

Jaw similar in outline to *Arabellites alfredensis* m., plate XXIII, fig. 4, but is much larger and heavier, and the surface sculpture is more gibbous. The denticles are blunt, flat, and triangular, while those in the preceding species are sharp and conical.

Arabellites bipennis sp. n.

MAXILLA I (Plate XXIII, figs. 8-10)

Jaw elongated; the outer margin curved inward to form a large hook; on the inner margin and perpendicular to it are from 4 to 6 large acute denticles; posterior margin notched by a deep crescent shaped indentation.

The jaws as a whole do not correspond closely to any figured by other authors. Hinde (1882) figured three specimens as *Arabellites spicatus* having the posterior margin incurved. The anterior portion, however, including the hook and denticles, compares rather well with *Arabellites alfredensis* m.

Genus NEREIDAVUS, Grinnell, 1877

Jaws elongate with blunt denticles, a distinct hook and a truncated posterior end. Jaws similar to Grinnell's genus *Nereidavus* were placed under the genus *Eunicites* Ehlers by Hinde (1879), (1880). The jaws under consideration resemble, to some extent, the jaws of the modern genus *Nereis* Linn. Hinde retained the genus *Nereidavus* for forms of this nature, *Nereidavus solitarius* and *Nereidavus antiquus*, and it seems best to follow at this time the precedent set by him.

Nereidavus perlongus sp. n.

MAXILLA I (Plate XXIII, figs. 11-16)

Jaw long and narrow with a prominent terminal hook; posterior extremity obliquely truncated; outer lateral margin gently curved, inner lateral margin nearly straight or slightly curved and furnished with 9 to 11 blunt denticles. The first denticle following the hook is much larger and curved forward. This seems to be characteristic of this form. The under surface has a large aperture, for the insertion of the muscle, which differs in structure in the left and right jaws.

Nereidavus antiquus Hinde is similar in form to *Nereidavus perlongus* m. but is smaller, the posterior end less truncated, and the hook and denticles are not so prominent.

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EXPLANATION OF PLATE XXII.

All figures magnified 13 times.

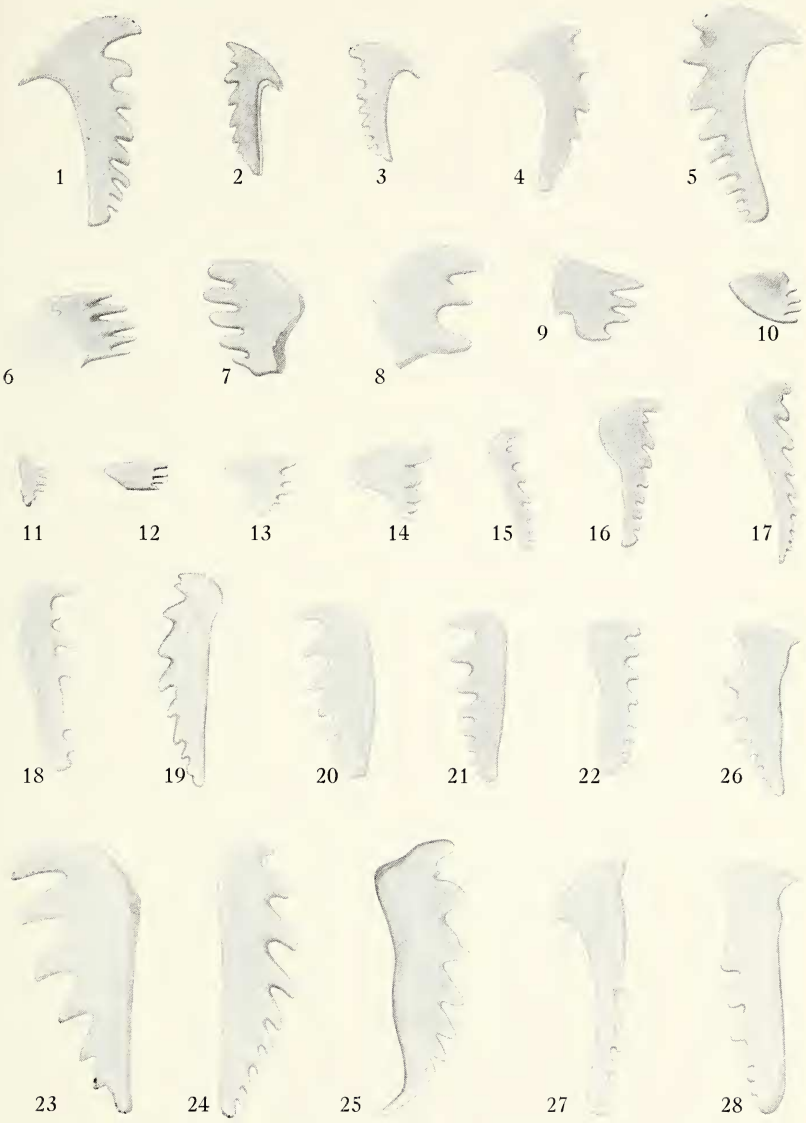
FIGS. 1–5 Eunicites anchoralis sp. n. Maxilla II, left and right jaws. Tiptop, near Alfred Station, N. Y.

FIGS. 6–14 Eunicites mutabilis sp. n. Maxilla III and IV, left and right jaws. Tiptop, near Alfred Station, N. Y.

FIGS. 15–25 Oenonites grandidentatus sp. n. Maxilla II, left and right jaws. Tiptop, near Alfred Station, N. Y.

FIGS. 26–28 Eunicites cautis sp. n. Maxilla II, left and right jaws. Tiptop, near Alfred Station, N. Y.

All specimens are in the Carnegie Museum under the numbers 6919-6924.



Annelid Jaws from the Upper Devonian of New York.